

REMARKS

Claims 2, 3, 14, 20 and 37-44 remain pending for further prosecution in the present application and claims 21-25 are withdrawn as being directed to a non-elected species but remain in the application in the event that they can be re-joined. Independent claims 2 and 37 have been amended to distinguish over the prior art of record. No new matter was added. Applicants respectfully submit that the present application is in condition for allowance and rejoinder is respectfully requested.

Claim Rejections - 35 USC §103(a)

- A. *In the FINAL Office Action dated August 4, 2011, claims 2, 3, 14, 20, 37, 38 and 42-44 are rejected under 35 USC §103(a) as being obvious over the publication of Fan et al. titled "Deformation behavior of Zr-based bulk nanocrystalline amorphous alloys" in view of U.S. Patent No. 4,992,095 issued to Nate et al.*

On page 7 of the FINAL Office Action dated August 4, 2011, the Examiner states the following:

"... applicant argues the 'powder grains' (i.e. gas atomized powder of amorphous metallic glass) are not and cannot exist within the structure of the cast samples disclosed by Fan et al. In response, the examiner notes that there is no recitation of the 'powder grains' or gas atomized powder in the sintered body target structure as claimed in the instant claims 2 and 37."

In direct response to the Examiner's above comments/suggestion, each of independent claims 2 and 37 of the present application has been amended to require the sintered body target structure to be made of sintered gas atomized powder such that the sintered body target structure has *powder grains* that form a constituent unit of the sintered body target structure. No new matter was added. For example, see FIG. 1 of the present application that clearly shows "powder grains" that form a constituent unit of the sintered body.

Based on the above stated claim amendments and for the reasons discussed below, Applicants respectfully request reconsideration and removal of the rejection.

The metallic glass sputtering target of the present invention is produced by sintering amorphous alloy powder which thereby produces a unique structure for a metallic glass sputtering target that is neither shown nor made obvious to one of ordinary skill in the art by the cited references. It should be clearly understood that powder grains are the constituent unit that forms the sintered target structure of the present invention (i.e., sintered body sputtering target made of sintered gas atomized powder of bulk amorphous metallic glass). By way of example, the “powder grains” of the sputtering target according to the present invention are clearly shown and can be readily observed in FIG. 1 of the present application, as filed.

In contrast, the amorphous alloy described in Fan et al. is produced as a casting that is manufactured by molten metal of an alloy being poured in fluent molten form into a copper casting mold. Accordingly, it is clear that “powder grains” (i.e., gas atomized powder of bulk amorphous metallic glass) are not and cannot exist within the structure of the cast samples disclosed by the Fan et al. publication.

The Fan et al. publication is a report describing findings upon examining the mechanical properties of alloys based on a compression test and observing plastic strain, ductility and like properties. Fan et al. clearly do not teach, suggest or disclose a method of producing a sputtering target based on the sintering method of the present invention such that the target has powder grains nor does Fan et al. teach or enable the physical properties that are produced thereby.

It should be clearly understood that the “nanocrystals” existing within the structure of the samples of Fan et al. are generated pursuant to the “plastic strain” caused by the hardening and annealing treatment of the samples. Unless the “nanocrystals” are uniformly generated across

the entire target (100mm or more in diameter as required of the sputtering target of the claims of the present application), the material cannot form a commercially viable sputtering target product. With respect to this requirement, Applicants refer to FIG. 3 of Fan et al. which clearly describes that the samples of Fan et al. contain “plastic strain” subject to a slip band and a shear band. These are defects which would render the material commercially useless as a sputtering target. (Further, the samples of Fan et al. would not provide the “uniform structure” required by the claims of the present application.) If such defects exist in a sputtering target, the defects will cause abnormal discharge and generate unwanted particles and nodules during a sputtering operation which form unacceptable, faulty and non-usable thin films. It should be clear that the claimed sputtering target is free of such “nanocrystals” and “plastic strain” (i.e., the claims of the present application require “an ultrafine and uniform structure with an average crystallite size of 1nm to 5nm, said average crystallite size of 1nm to 5nm being uniform entirely throughout said sputtering target, and said target structure being of an amorphous state in which a grain boundary is not observable and being without any crystal growth”).

Thus, Fan et al. fail to make the subject matter of claims 2 and 37 of the present application as now amended obvious to one of ordinary skill in the art relative to the structure of a metallic glass sputtering target.

On page 9 of the FINAL Office Action dated August 4, 2011, the Examiner states the following with respect to the secondary reference:

“Nate et al. ('095) further discloses that the composition and structure of a film deposited by sputtering a sputtering target would be similar to the composition and structure of the sputtering target (col. 1, lines 49 to col. 2 line 31) indicating that the structure of the sputtering target itself would be amorphous in order to make a thin film of amorphous materials by sputtering the sputtering target.”

Nate et al. disclose that the compositional variation between a target and a thin film can be reduced by causing a specific additive to be eccentrically-located in the target structure and by preventing the existence of simple substance phases of transition metals. Nate et al. teach that the above stated target will not crack easily, that the uniformity of the film composition will be favorable, that the usage efficiency of the target will be improved, and that the film composition will not change with the passage of time. See column 1, lines 49-65.

Nevertheless, Nate et al. clearly fail to disclose or describe anywhere in the specification of the Nate et al. patent that the “structure” of the thin film obtained by sputtering the target is similar to the “structure” of the target. Thus, Applicants respectfully submit that the Examiner has erred in concluding that Nate et al. discloses that the “structure of a film deposited by sputtering a sputtering target would be similar to the ... structure of the sputtering target (col. 1, lines 49 to col. 2 line 31) indicating that the structure of the sputtering target itself would be amorphous in order to make a thin film of amorphous materials by sputtering the sputtering target.” For this reason, Applicants respectfully request reconsideration and removal of the rejection.

Nate et al. disclose that their target has a mixed structure of an intermetallic compound phase and a fine mixed phase. See column 2, lines 9-30. The fine mixed phase is obtained by finely mixing rare earth elements, and the intermetallic compound of rare earth elements and transition metals, and is generated based on the reaction of eutectic crystals, peritectic crystals, quasi-peritectic crystals and the like that occurs when the melt is cooled to normal temperature. In addition, it may also be a structure, which had taken on an amorphous form as a result of being quenched, becoming a crystalline structure through heating. See column 3, lines 19-26.

The eutectic crystals, peritectic crystals, and quasi-peritectic crystals described above are expressions that are used for describing the crystal composition of alloys, and they do not describe amorphous compositions.

Moreover, Nate et al. describe that, as conventional art (namely, JP 62-070550), a sputtering target is known that has a mixed structure made of an intermetallic compound phase of rare earth elements and transition metals and a simple substance phase of transition metals. See column 1, lines 29-35, of the Nate et al. patent.

JP '550 is an application publication by the same Applicant as the Nate et al. patent. The Nate et al. patent is an improvement made to the subject matter disclosed in JP '550. Nate et al. achieves an improvement to that of JP '550 by causing the simple substance phase of transition metals (Fe, Fe-Co) to substantially not exist in the structures shown in FIGs 6a-c and 7a-c of JP '550 by adjusting the composition of the raw material powder of JP '550.

FIG. 6 of JP '550 contains eutectic crystals in the intermetallic compound. This is clearly not amorphous. The composition shown in FIG. 7 of JP '550 is also clearly not amorphous since JP '550 describes that Gd generates an intermetallic compound between Fe and Fe-Co and a part thereof is melted and forms eutectic crystals.

Accordingly, Nate et al. clearly suggest that the structure of their target is not amorphous. JP '550 is being cited in an Information Disclosure Statement filed herewith and provides further evidence that Nate et al. fail to disclose a target that is of an amorphous material.

Thus, as argued in Applicants last response, Nate et al. teach that sputtering can be used to form a "thin film" of an amorphous alloy specifically made of rare earth elements and transition metals. However, it should be clearly understood that Nate et al. do not teach that it is possible to manufacture amorphous "targets".

Nate et al. disclose a sputtering target of a specific composition made by sintering powders. However, the structure of the “target” of Nate et al. is not amorphous. Rather, the structure of the “target” of Nate et al. is clearly required to include a mixed structure of a crystal phase. In addition, its composition is required to contain rare earth elements (10 to 50at%) as an essential component. Accordingly, the structure of the target taught by Nate et al. to one of ordinary skill in the art is completely different to that of the present invention as recited in the pending claims of the present application. Still further, Examples 1 to 3 of Table 1 of Nate et al. require the mixed crystal phase to be 30 to 100 μ m (see column 9 under the heading “Result of Microscopic inspection”/“Fine Mixed Phase”/“size (μ m)”), which is extremely larger than the crystallite size and scale required of the powder grains within the target required by the claims of the present application.

Applicants respectfully submit that the Examiner has misinterpreted the subject matter disclosed by the Nate et al. patent. Nate et al. may teach that a specific material may be formed into a sputtering target by sintering powders and that this sputtering target can be used to form amorphous thin films; however, Nate et al. clearly fail to disclose the structure of the sputtering target is amorphous. In fact, Nate et al. disclose the opposite. The target of Nate et al. is required to include a mixed crystal phase having an average grain size of 30-100 μ m as discussed above and as clearly disclosed in the Nate et al. patent.

By way of example, column 1, lines 18-35, of Nate et al. discloses that thin films of amorphous alloys comprising a rare earth element and a transition metal such as Tb-Fe-Co or Gd-Tb-Fe are usable as magneto-optical recording media. Column 1, lines 25-28, of Nate et al. specifically teaches that “as a method of manufacturing a thin film of such amorphous alloy, a sputtering method ... is often used”. Thus, while the thin film is required to be an amorphous

alloy thin film, there is no teaching or suggestion provided by Nate et al. that the structure of the sputtering target itself is amorphous.

Further, column 1, lines 29-35, of Nate et al. discloses an example of a prior art target which has “a mixed structure comprising a phase of intermetallic compound of rare earth element and transition metal and a phase of transition metal alone” and which is clearly not amorphous.

Column 2, line 31, to column 4, line 68, of Nate et al. discloses a sintered sputtering target having the above discussed mixed crystal phase having an average grain size of 30-100 μ m. Again, while the thin film produced by the sputtering target may be amorphous, the sintered body sputtering target of Nate et al. is not. During a sputtering operation, the composition of the thin film is necessarily the same as the target; however, the microstructure is not necessarily the same between the target and thin film.

For this reason, Applicants submit that the rejection of the claims of the present application as obvious over Fan et al. in view of Nate et al. is in error and should be reconsidered and withdrawn for the reasons discussed above. Applicants respectfully submit that the combination of prior art references does not teach the target structure required by the claims of the present application. Fan et al. fail to disclose a sputtering target or a sintered structure formed of powder grains, and Nate et al. disclose a sintered sputtering target having a mixed crystal phase of an average grain size of 30-100 μ m. One of ordinary skill in the art relying on common sense and producing a sintered body sputtering target based on this combination would produce a target body having a mixed crystal phase of an average grain size of 30-100 μ m as clearly directed by the teachings of the Nate et al. patent which is the only reference that discloses a sputtering target.

Accordingly, for all the reasons discussed above, Applicants respectfully submit that independent claims 2 and 37 of the present application are not obvious over Fan et al. in view of the Nate et al. patent. Applicants respectfully request reconsideration and removal of the rejection.

B. In the FINAL Office Action dated August 8, 2011, claims 39-41 are rejected under 35 USC §103(a) as being obvious over the publication of Fan et al. titled “Deformation behavior of Zr-based bulk nanocrystalline amorphous alloys” in view of U.S. Patent No. 4,992,095 issued to Nate et al. and further view of the publication of Kakiuchi et al. titled “Application of Zr-Based Bulk Glassy Alloys to Golf Clubs”.

Applicants respectfully submit that dependent claims 39-41 are patentable over Fan et al. in view of Nate et al. and further in view of Kakiuchi et al. for the same reasons discussed above that independent claims 2 and 37 are patentable over Fan et al. in view of the Nate et al. patent.

Accordingly, Applicants respectfully request reconsideration and removal of the rejection of claims 39-41.

Conclusion

In view of the above amendments and arguments, Applicants respectfully submit that the rejections have been overcome and that the present application is in condition for allowance. Thus, a favorable action on the merits is therefore requested.

Please charge any deficiency or credit any overpayment for entering this Amendment to our deposit account no. 08-3040.

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